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EFFECTS OF THE PRACTICE OF PILATES IN PREGNANCY: A LITERATURE REVIEW

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Abstract: Pregnancy is one of the most anticipated moments in women's lives. However, biological and physiological changes cause a lot of discomfort, and the possibility of the occurrence of various diseases. Exercise may be a good alternative to bring relief and welfare to these women and Pilates, one of the fastest-growing modalities of exercise in the world which is currently used not only in fitness, but also in rehabilitation, injury prevention and health promotion, is a modality that has been widely recommended as an adjunct in the treatment of various diseases. Nevertheless, many people step into an exercise program aiming to have a healthier life without thinking in their ongoing participation. Thus, pregnant women adhering to an exercise program require some care and a general health assessment including medical and obstetric risks have to be considered. To this end, the Pilates instructor should know the audience and the specific needs of the group in question to check if there are any contraindications for the exercise and to determine the best frequency, intensity and amount of exercise to be prescribed. Therefore, this paper aims to review the effects of the practice of Pilates in pregnant women during and after labor listing its benefits and peculiarities of its prescription.

Keywords: bleeding, exercise, hypertension, Pilates, pre-eclampsia, pregnancy.

INTRODUCTION

One of the fastest-growing modalities of exercise in the world is Pilates method. If dancers and athletes were originally the prevailing public, today Pilates has been widely used not only in fitness, but also in rehabilitation, injury prevention and health promotion, attracting many other social groups¹.

This new way of understanding and practicing the method makes possible new approaches transcending the classical perception and allowing to understand Pilates as a polysemic tool before achieving the various goals of the practitioner and not only as a means to justify itself. Therefore, each day more pregnant women seek

Pilates to get more relief by minimizing the biological offsets which occur in this period.

We all know that pregnancy is one of the most anticipated moments in women's lives. However, biological and physiological changes cause a lot of discomfort, and the possibility of the occurrence of various diseases².

Among these various changes, one of them shows up in locomotor system causing lumbar hyperlordosis and changes in center of gravity due to the anterior rotation of the pelvis^{2,3,4}. In addition to this, about 25% of all women experience some symptoms of musculoskeletal discomfort that may be, even temporarily, disabling. One of the most common symptoms is low back pain, which can reach 90% of pregnant women⁵.

Within psychological and social aspects, physical exercise can help fight prenatal depression, which despite being well studied, can affect both the mother and the fetus, and reach about 10% of pregnant women. This condition also leads to poor adherence to prenatal visits, which has been strongly associated with neonatal mortality^{6,7}.

Weight gain is also a worrying factor in pregnant women, since it is quite common in this period and reaches about 46% of them. Pregnant women who exercise tend to gain less weight than pregnant women who do not exercise, thereby reducing risks both to their health and fetal health. Pregnant women who are overweight tend to do more cesareans, develop preeclampsia and obesity postpartum⁸.

Pilates can be considered an important tool in this period, because the exercise has been recommended as an adjunct in the treatment of various diseases⁴. Nevertheless, many people step into an exercise program aiming to have a healthier life without thinking in their ongoing participation.

Thus, pregnant women adhering to an exercise program require some care and a general health assessment including medical and obstetric risks have to be considered. To this end, the Pilates instructor should know the audience and the specific needs of the group in question.

In addition, some partial contraindications such as severe anemia, hypertension or uncontrolled diabetes, morbid obesity, among others, or yet total contraindications such as pre-eclampsia, bleeding in the first trimester of pregnancy, risk of premature birth, among others, should be observed⁹.

Physical exercises may be beneficial during pregnancy and postpartum, and although pregnancy is a time for changing lifestyle, some care that should be taken within the first months of pregnancy may discourage the practice of a number of activities. This is another point that should be planned and reflected by Pilates instructor.

In general, there are many ways that physical exercise can benefit pregnant women and for this reason we must be prepared to meet the public. Studies also show that pregnant women who exercise until the last day of pregnancy, besides having fewer complications in labor, give birth to healthier children. These results endure over the years, because these children tend to have better school performance and develop fewer diseases⁵.

Thus, the aim of this review is to suggest Pilates as a form of exercise that will stimulate positive biological adaptations in women during pregnancy, minimizing their discomfort and providing a better perspective in life.

PILATES METHOD

Pilates method was created by Joseph Hubertus Pilates (1883-1967) born in Germany in 1883. During his childhood he suffered with health problems resulting from rickets, asthma and rheumatic fever¹.

Trying to overcome his biological weaknesses he began his studies on the anatomy of the human body, especially in relation to posture and respiratory diseases. His aim was self-treatment. That is, he was looking for a stronger, more efficient, and healthier body. It all started when the family doctor gave him an ancient and discarded book of Anatomy. Joseph memorized all parts of the body and moved them to root the theoretical and the practical knowledge^{1,4,12}.

Despite his complicated childhood, Joseph became a relatively healthy teenager. In 1912, after the outbreak of World War II he was cloistered on the battlefield in Lancaster in England. At this time, the world had suffered a great flu epidemic that killed thousands of people, aggravated by unsanitary conditions. At this time, Joseph was already testing the creation of Pilates encouraging other prisoners to exercise^{13,14}. After some time, he was transferred to another battlefield in which he was intended for a nurse. At that point, he adapted strings from car carburetors and

hospital beds to set overload on exercises for bedridden soldiers, and thus new evidence of the method we now call Pilates arose by that time^{1,15}.

After the war, he returned to Germany and unhappy with some political issues, he decided to abandon his homeland. Thus, in 1926 he makes his second and final trip to New York, the first of which had been on vacation. This time, he met his last wife who was called Clara⁴.

After reaching the American city, Joseph and Clara were invited to manage a boxing gym where Joseph created several devices, a methodology and self principles for the Pilates method. These principles are known as Contrology, concentration, proper breathing, recognition of the body or proprioception, precision, fluidity and power house^{10,16}.

Even though influenced by a number of other activities such as ballet, meditation techniques, weight training and yoga, Pilates method brought an essence coming specifically from its creator. The original name of the method was Contrology, it turned to be called Pilates only after Joseph's death in 1967^{10,11,17}.

Finally, the method can be understood as a kind of systematized training, which enables the maintenance or increase in flexibility, posture, cardiorespiratory fitness and valences of strength training such as hypertrophy, power, endurance and muscle strength. It also uses specific principles and instruments with the objective of stimulating social, biological and psychological adjustments in favor of treatment, physical conditioning, injury/disease prevention and health promotion in general^{1,4}.

MAIN BIOLOGICAL CHANGES DURING PREGNANCY

During pregnancy, a woman's body undergoes many biological changes. Besides the uterine and fetal growth, important changes in locomotor, cardiorespiratory system, metabolism and body composition and aesthetics occur¹⁸. In addition to this, pregnancy is characterized by several physiological, biochemical and endocrine adjustments targeted to promote a favorable environment for the development of the fetus¹⁹.

Starting the discussion by body composition, it is known that the pregnant woman undergoes some changes in this field, the main one concerning weight gain by increasing fat and lean mass. The gain of fat mass occurs by increasing the intake of some nutrients⁴, while the increase in lean body mass is due to the large amount

of energy demand required for the development of the fetus, altering metabolism and homeostatic mechanisms²⁰.

Considerable changes in secretion and insulin sensitivity also occur, as the resistance to it progressively increases and with greater intensity around the 24th week of pregnancy, allowing a greater supply of glucose to the fetus coupled with the increase in blood glucose²¹. Due to these factors, it is necessary and suggestive an adequate follow-up of a professional to prevent excessive gestational weight gain, which may cause a framework for gestational obesity, which in turn could impact in numerous acute and chronic complications. Studies also report that the gain of fat mass may last up to 3 years after pregnancy²².

Regarding the distribution of weight gain during pregnancy, during the first and second quarters, fat gain, increased plasma and abdominal volume are predominant factors for weight gain, while from the third quarter on weight gain is related to fetal growth and increased amniotic fluid²³.

Thinking of the locomotor system, the main changes concern the increased abdominal girth due to the growth of the uterus, causing the protruding abdomen, diastasis of the rectus abdominis, modified center of gravity and increased lumbar lordosis. In addition, there are changes in the alignment of the pelvis due to the relaxation in cartilage that form the pubic symphysis and ligament laxity due to the secretion of hormones such as relaxin, widening the pelvic cavity for future passage of the fetus. There is also a weakening of the pelvic floor muscles due to increased intra-abdominal size and weight gain in this region^{4,24,25}.

Due to uterine expansion and adoption of compensatory postures, the spine undergoes exacerbated efforts, emphasizing its physiological curvatures and causing pains mainly in the cervical and lumbar regions^{26, 27}. The stretching of the abdominal muscles as a result of increased intra-abdominal volume and contraction of the paraspinal musculature are important characteristics that explain the loss of abdominal strength, neck pain and back pain²⁸.

In addition to what has already been discussed, we can report that the spine is the body part that suffers most changes during pregnancy, accentuating its curves and causing overloads due to weight gain, breast, uterine and abdominal growth, pelvic anteversion, hip lateral rotation, fluid retention and ligament laxity due to an increased production of the hormone relaxin²⁹. Due to greater mechanical stress and

overload, there is an increased fatigue of the muscles of the spine, and scientific literature points at it as an indicator for the increased prevalence of lumbar pain³⁰.

The practice of specific exercises for pregnant women significantly contributes to the decrease in the number of low back pain when compared to pregnant women who do not perform physical exercise³¹. Activities such as Pilates method provide significant improvements with respect to posture, reduction in back pain, improved breathing, and feeling physically and mentally well-being³², as we shall see in greater depth in future reflections.

Due to increased metabolic changes during pregnancy, there is a larger work of certain glands and hence the dosage of some endogenous hormones. Maximizing of the production of estrogen and progesterone would be an example. These hormones are responsible for changing the size of the breasts, inducing the production of breast milk, increasing uterine walls, modifying female sexual characteristics, among others⁴.

In contrast, an increased release of the progesterone hormone negatively affects muscle tone, especially reducing contractility and control of the sphincter muscle, which together with increased uterine pressure on the bladder reduces the ability of the restraint of urine, corroborating the increase of urinary incontinence episodes²⁵.

There are also unstable mood swings that can be stimulated by changes in the nervous and hormonal systems¹⁸. In sum, physiological changes can occur in the skin, as the appearance of pimples, stretch marks, pigmentation, besides the abnormal growth of hair and nails³³.

Thinking of the cardiorespiratory system, the increased secretion of progesterone stimulates the respiratory center to increase breathing amplitude, causing a 50% increase in lung ventilation³⁴. Studies show that about 75% of pregnant women experience dyspnea as a result of hyperventilation. These changes result in a decrease in functional residual capacity, a factor that can increase hypoxemia caused by acute asthma, manifested by the premature airway closure, causing pregnancy complications^{34,35}.

Changes and sleep disturbances can also occur with some frequency³⁶. There are several studies that link snoring during sleep and excessive sleepiness during the day with pregnancy. These symptoms tend to increase in parallel with the advancement of pregnancy³⁷. Hemodynamic changes such as increased cardiac

output and increased retention of sodium and water are also observed during this period^{38,39}.

In addition to these changes, which are most common in the period in question, other ones may occur stimulated by lifestyle and work. These and all other changes detected during an assessment prior to the beginning of Pilates sessions should be taken into account when prescribing exercises.

PRESCRIPTION OF EXERCISES, SUGGESTIONS AND CONTRAINDICATIONS

We have vast literature that emphasizes the practice of Pilates and other exercise modalities as something that could help minimizing biological complications that occur during pregnancy, besides the improvement of the indices related to miscarriage and preterm delivery^{41,42}. In spite of having sufficient data to defend the point of view that the practice of systematic exercise produces beneficial effects in humans, we need to understand, in a qualitatively and quantitatively perspective, to what variables of the exercises these numerous studies are referring to.

We affirm this, as one of the greatest difficulties that the Pilates instructor faces when you have a pregnant student is precisely the proper exercise prescription as its intensity, duration and weekly frequency.

For so long a pregnant woman was understood as a weak individual and lacking only physical activities that would put her in movement without any incentive to increase biological adaptations. As exemplified in some studies, the practice of physical activity, as it is for Pilates, could not exceed a heart rate (HR) of 140 bpm and a 15-minute duration^{43,44}.

However, more recent studies demonstrate that although it is still a controversial subject and respecting the specific needs of pregnancy, the pregnant woman can also practice long-term exercises on a daily basis with intensities ranging from moderate to high^{4,44}.

The average intensity of exercise suggested in most studies is quite below the capacity of the pregnant woman. This score ranges from 60 to 70% of their aerobic capacity or 120-140 bpm for other sports. Other means would be 55% of HR_{max} or 50% of VO_{2max} [19, 45]. Besides HR, oxygen consumption and aerobic capacity, there is still the possibility of using the subjectivity of the woman's own perception or scales like Borg's Perceived Exertion, since fatigue in certain regions, such as the

legs, will affect the performance in several exercises⁴. In summary, the most consistent recommendation in the literature is the realization of exercises of mild to moderate intensity. However, we must bear in mind that this measure is only to ensure the safety of pregnant women, as for a woman athlete, for example, training could be performed at a higher intensity without causing any inconvenience to the mother or the fetus.

As regards the duration of the exercise it is possible to find in literature suggestionsof an average of 30 minutes daily and 150 minutes weekly sessions^{9,44,46}. Once again it has to be taken into consideration that these are parameters seeking the practitioner security, but longer durations than those highlighted in literature are quite feasible and the Pilates instructor himself is the most important agent to establish which will be the best duration of the exercise after a well done assessment.

As for the weekly frequency, which is also a consensus in literature, it is suggestedto conduct activities 3 to 4 days per week in non-athletic women and with greater frequency and intensity in female athletes^{4,42,44,47}. Again, these suggestions should be evaluated and, respecting the principle of biological individuality, modified according to each practitioner.

The most recommended exercises, beyond Pilates itself, are swimming, hiking, yoga, among others that can be adapted to not cause an intense and disproportionate effort to the physical condition of the woman⁴¹.

Exercises less suitable are those which can cause some impact or physical contact in the abdominal region. Some examples are football, horse riding, diving, basketball and handball^{4,44,48}.

Besides, there are some relative and absolute contraindications as for the participation of pregnant women in an exercise program. Relative contraindications state that pregnant women may take part in an exercise program as long as the Pilates instructor is aware of some conditions he should take into consideration such as anemia, obesity, heart and thyroid disorders, hypertension, diabetes, and other similar ones. When the practitioner has any absolute contraindication, exercise should be avoided until the cause of the problem is normalized. Some of them are severe or uncontrolled heart and lung diseases, such as heart failure and recent pulmonary embolism, uterine bleeding, acute infectious diseases, or similar ones^{19,49}.

Incorrectly prescribed exercises in Pilates can cause complications such as bleeding, dizziness, prolonged dyspnea, pains and abnormal movement of the fetus. In these or similar situations, the practice of exercise should cease and the pregnant woman be referred to a physician.

The moderate and high intensity exercise should be avoided in places of very high temperature, since the thermoregulation of the pregnant woman is not so efficient and hydration is an important feature to be taken into consideration⁴². At the most, after conducting a pre-exercise assessment, the Pilates instructor will be prepared to prescribe exercises with intensity, duration and frequency consistent with the needs of pregnant women.

KEY BENEFITS OF PILATES PRACTICE

Since its creation, the Pilates method has been used both in rehabilitation and for fitness, aesthetics and health promotion⁵⁰. These exercises may be challenging even for trained individuals and athletes⁵¹. Thus, it's a method able to meet the most varied profiles, providing many benefits on the varied needs of the practitioner, including pregnant women⁴.

Sedentary pregnant women, the most common public in Pilates, when compared with athletes, show a great fitness deficit, increasing the risk of certain diseases during and after pregnancy. This finding confirms the importance of exercise through the gestational period, and Pilates is one of the most suitable methods indicated by health professionals⁵².

Many are the benefits of exercising during pregnancy. One of the biggest complaints during pregnancy is constant nausea and vomiting. About 80% of women feel both symptoms from the first trimester^{4,53}. A recent study showed that exercise, such as Pilates, significantly decreases nausea in the first quarter and vomiting in the second trimester of pregnancy⁵³. It may seem a simple benefit, but it is a strong indicator of improved quality of life during this period.

Another benefit of the practice of Pilates is related to the treatment of back pain, which is one of the most debilitating symptoms of pregnancy. Studies show that 61% to 88% of women experience back pain during pregnancy, ranging from mild discomfort to severe pain^{54,55}. Pilates has been often used in the prevention and treatment of this type of pain^{56,57}, as one of the foundations of the method is the core

(or Power House) stabilization and strengthening. Exercises that promote trunk stabilization associated with the stretching of the hamstrings have been portrayed with significant positive results in relieving this symptom⁵⁸.

Another condition that affects up to 14% of the female population during pregnancy is Gestational Diabetes Mellitus (GDM)⁵⁹. Factors such as obesity and family history potentiate the risk of developing GDM, affecting not only the health of women, but also the fetus. Metabolic complications may also cause possible birth complications, macrosomia, pre-eclampsia and bleeding, and the risk of developing type 2 diabetes after pregnancy⁶⁰. In addition to these endogenous factors, exogenous ones, such as sedentary lifestyles, further increase the risk of developing this disease⁶¹.

This occurs because during pregnancy women tend to decrease or stop the practice of physical exercises⁶². About 23% of women who exercised before pregnancy, stop exercising when they enter this new phase of life^{63,64}.

The daily practice of Pilates or other exercise modality has been advocated because it assists in improving insulin resistance and, consequently, minimizing the GMD. As already said, Pilates is an interesting tool because it can be adapted to many different purposes and profiles of practitioners⁶⁵.

For different types of purposes, including for the GMD, the American College of Obstetricians and Gynecologists recommends a minimum of 30 minutes of moderate exercise being performed daily⁶⁴.

Another continuing problem that affects the health and quality of life of women is urinary incontinence, as it is considered a risk factor especially during pregnancy and childbirth⁶⁶. As saw earlier, it is related to pelvic disorders, overactive bladder syndrome and pelvic organs prolapse. A prevalence of 24% of the female population is affected by this disorder⁴. Studies show a strong association between pelvic disorders and risk factor in vaginal delivery^{67,68}.

Pilates would help to minimize these discomforts as its methodology is based on stabilization of the center of force (Core) or Power House, as it is called in Pilates, which consists of the contraction of the transversus abdominis muscles, multifidus and pelvic floor (perineum) responsible for static and dynamic body stabilization. During execution of the exercises, the method requires the central balancing of the body by activating the Power House, associated with the control of breathing⁶⁹.

In addition, exercises that specifically train the pelvic floor muscles are used as treatment for urinary incontinence⁷⁰. Thus, Pilates is shown to be a favorable method for the prevention and treatment of this disorder if we take into consideration that its principles of controlling and stabilizing the central part of the body also strengthen the pelvic floor musculature.

Another benefit would be the reduction of symptomatic dyspnea throughout the pregnancy due to the specific diaphragmatic breathing training in Pilates and stimulation of concentration during the exercises and tasks of daily life, favoring the perception of well-being before and during labor⁴.

In summary, there are various benefits of practicing Pilates for promoting women's health during and after pregnancy.

CONCLUSION

Based on the literature reviewed, Pilates can be suggested as a favorable modality of exercise to be practiced during pregnancy, because of its benefits for the prevention and treatment of various diseases that can affect women in this period.

Surveys used in this article point to many benefits achieved by regular exercise during pregnancy, except in specific cases where health professionals evaluate and consider their practice unfeasible.

In other words, when Pilates is prescribed appropriately, it has been proving to be a powerful tool for health promotion, prevention and treatment of diseases that may affect women during pregnancy.

In last words, we believe it is important to warn that the Pilates method is just a tool for professional intervention. When properly engineered, it might be critical to the well being of the practitioner, however, if it is prescribed in a bad way, it might be a source of injuries and aggravation in pre-installed pathologies. Thus, it is not the Pilates method that assists in the promotion of women's health in pregnancy, but the instructor properly using the method.

We also emphasize the need for more papers that specifically address the Pilates method on the above subject, once the specific ones are very scarce.

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